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㊼特許請求の範囲

1　操作部に体腔内へ挿入すべき挿入部を連結し、上記操作部での操作によりその挿入部を湾曲するようにした軟性内視鏡において、上記挿入部および操作部にわたつて内装され先端部が挿入部の先端部位に固定された長尺の光学繊維束と、この光学繊維束の基端側部分に連結され、その光学繊維束をその基端側の方向へ弾性的に付勢してその光学繊維束に生じるたるみを防止する弾性部材とを具備してなることを特徴とする軟性内視鏡。

2　上記弾性部材は上記操作部内に設置され、かつ弾性的に引き伸した状態でその一端は上記光学繊維束の外装チューブに連結し、他端は操作部内に設けた支持部材に連結してなることを特徴とする特許請求の範囲第1項に記載の軟性内視鏡。

3　上記弾性部材は上記光学繊維束に被嵌する弾性チューブであることを特徴とする特許請求の範囲第2項に記載の軟性内視鏡。

4　上記操作部内における光学繊維束部分の全光学繊維に対して固定される固定部材を設け、この固定部材を介して上記光学繊維束に上記弾性部材を連結することを特徴とする特許請求の範囲第1項に記載の軟性内視鏡。

発明の詳細な説明

本発明は湾曲される挿入部に光学繊維束を内挿する軟性内視鏡の改良に関する。

一般に、軟性内視鏡の挿入部は挿入対象たる体腔の形状に沿つて自由に曲り得る可撓管の先端に湾曲管を設けてなり、この湾曲管部分は手元操作部における遠隔操作により強制的に大きく湾曲させられるようになつている。ところで、この挿入部の内部には照明用光学繊維束や観察用光学繊維束が内装されている。そして、これらの光学繊維束は挿入部の中心軸に位置することはなく、左右上下に片寄つて配置されるのを普通とする。したがつて、挿入部、特に湾曲管部分が湾曲した場合、中心軸を境として湾曲内側ではその軸方向に収縮し、湾曲外側ではその軸方向に伸長することになる。そして、この収縮と伸長の作用を内装する上記各光学繊維束が受けることになる。ところで、この光学繊維束はその性質上ほとんど伸縮しないので、上記湾曲時において湾曲内側の光学繊維束は基端側へ押しやられ、湾曲外側では先端側へ引張られるようになる。

ところが、内視鏡の挿入部は患者の体腔内へ挿入することから患者の苦痛の軽減を図る上で極力外径を細くしてあり、これに伴つて内蔵部材の充填率もきわめて高くなつている。このため、上記各光学繊維束の軸方向の動きは阻害され抵抗を受けやすい。ところで、各光学繊維束はそれ自体柔

軟な可撓管を有するので、湾曲内側となつて基端側へ押されたとき、容易にたるみ狭い挿入部内で蛇行して一段と抵抗を増すことになり、そのまま湾曲操作を続けると、その光学繊維束に作用する圧縮力が大きくなる。

また、湾曲外側のものについても、湾曲を元に戻す際には同様に圧縮力が大きくなる。

ところで、上記光学繊維束は引張り力に対してはある程度の耐性力があるが、圧縮力には非常に弱いので、湾曲操作時（特にその繰り返し操作時）において光学繊維素子が多数座屈して折れ、観察や照明に支障をきたして使用不可能にしてしまうという重大な欠点があつた。

本発明は上記事情に着目してなされたもので、その目的とするところは挿入部を湾曲する際、内装される光学繊維束に生じようとするたるみを吸収し、光学繊維束に軸方向の圧縮力を生じて座屈して折れることを防止するようにした軟性内視鏡を提供することにある。

以下、本発明の一実施例を第1図ないし第5図にもとづいて説明する。

第1図中1は軟性内視鏡であり、これは操作部2、体腔内に挿入される長尺の挿入部3、および操作部2に連結されたライトガイド用ケーブル4とからなる。上記挿入部3は可撓性をもつ可撓管5の先端に湾曲管6を介在させて先端部材7を連結してなり、上記湾曲管6は後述する操作ワイヤ8，8を操作部2のアングルノブ9の操作により押し引きして遠隔的に湾曲させられるようになつている。上記可撓管5の基端は第4図で示すように操作部3の本体11に対して連結固定されており、この部分の外周には折止めゴム管12が被嵌されている。また、湾曲管6は第2図および第3図で示すように挿入部3の長手軸方向に沿つて複数の節輪13…を配列するとともに、その隣り合う節輪13…を回動軸14…で枢着することにより全体として湾曲する芯材15を構成してなり、この芯材15の外周に外皮16を被覆して構成されている。そして、上記操作ワイヤ8，8は回動軸14…から最も遠く位置するように芯材15の内周付近にそれぞれ配置されており、その各先端は先端部材7に取付け固定されている。また、操作ワイヤ8，8の基端側は可撓管5内に配設された密巻きコイル製のワイヤガイド17，17に対してそれぞれ挿通されて操作部2に案内され、図示しない湾曲操作機構に連結されていて前述したように押し引きされるようになつている。

さらに、上記操作部2および挿入部3の各内部にはその両者にわたつて照明用光学繊維束18と観察用光学繊維束19とが挿通されている。そして、照明用光学繊維束18の先端部は先端部材7に嵌入固定されるとともに照明窓21に対して光学的に連結されている。また、観察用光学繊維束19の先端部は同じく先端部材7に嵌入固定されるとともに観察窓22における対物レンズ23に対して光学的に連結されている。さらに、照明用光学繊維束18の基端側は操作部2からライトガイド用ケーブル4内を通り、コネクタ24に達している。また、観察用光学繊維束19の基端側は操作部2の接眼部25に対して光学的に連結されている。また、上記各光学繊維束18，19はたとえばシリコンゴムなどのように弾性的に伸縮し得る外装チューブ26，27によつてそれぞれ被覆されている。

一方、上記操作部2の内部には第4図および第5図で示すように円板状の支持部材28がその操作部2の長軸方向に直交する向きで配置され、操作部2の本体11から延出する枠部29に取付け固定されている。さらに、この支持部材28には上記各光学繊維束18，19をそれぞれゆるく挿通する一対の貫通孔31，32と上記各操作ワイヤ8，8をそれぞれゆるく挿通する一対の通孔33，33が設けられている。

ところで、上述したように操作部2および挿入部3にわたつて内装された各光学繊維束18，19の基端側部分はたるみ防止用の弾性部材によつてその基端側の方向へ弾性的に付勢する手段によつて引かれている。すなわち、この実施例にあつては第4図および第5図で示すように操作部2の本体11内における各光学繊維束18，19の外周に弾性部材としての外装チューブ26，27の外周にそれぞれ引張りチューブ35，36をゆるく被嵌してなり、この各引張りチューブ35，36の一端を上記外装チューブ26，27における上記支持部材28よりも先端側に位置する部位の外周に固着して連結するとともに各引張りチューブ35，36の他端をそれぞれ対応する貫通孔31，32に嵌め込み固着部材33，34によつて

その支持部材２８に固着して連結したものである。さらに、上記各外装チューブ２６，２７はそれぞれ引張チューブ３１，３２によつて引き伸ばされた状態で取り付けられている。これにより上記外装チューブ２６，２７をその基端側へ引くように弾性的に付勢する手段を構成するものである。したがつて、外装チューブ２６，２７は引き伸ばされた状態で真直ぐになつている。また、支持部材２８よりも基端側で操作部２の本体１１内に位置する光学繊維束１８，１９の部分は適度なたるみをもたしてあり、先端側へある程度は引き出せる余裕がある。

しかして、上記構成において、挿入部３の湾曲管６をたとえば第２図中点線で示すように強制的に湾曲させた場合、その湾曲内側に位置する照明用光学繊維束１８は圧縮されて基端側へ押されるが、これは前述したように引き伸ばされることによつて常に真直ぐな状態を維持する外装チューブ２６に包まれているため、たるみを生じない。このとき湾曲外側にある観察用光学繊維束１９は逆に先端側へ引つ張られるが、支持部材２８の後方の操作部２内において適当な余裕をもたしてあり、また、外装チューブ２７には弾性があるので、無理なくこれらを先端側へ引き寄せることができる。

次に、上記湾曲状態から元に戻され逆に湾曲させられる際には両光学繊維束１８，１９の移動方向は上記の場合と逆となるが、このときもやはり外装チューブ２７の作用によつてたるむことはない。このように狭い挿入部３内に内装された各光学繊維束１８，１９はその途中でたるむことがないので、その軸方向の滑動が円滑に行なわれる。つまり、たるみによりその軸方向の滑動が阻害され、圧縮力に対して著しく弱い光学繊維に圧縮力を与えて座屈し折損させることを未然に防止できる。

なお、この実施例においては外装チューブ２６，２７を弾性部材として利用したが、上記引張りチューブ３５，３６に弾性をもたしてこれを利用してもよい。つまり、外装チューブ２６，２７と引張りチューブ３５，３６の少なくとも一方が弾性的に伸縮するものとすればよい。

第６図は本発明の他の実施例を示すものである。この実施例は操作部２の本体１１内に位置する各光学繊維束１８，１９の中途部分が管状の固定部材４１，４１に一体的に取付け固定されている。この固定部分における光学繊維は接着剤により一体に固められている。さらに、この固定部材４１，４１は支持部材２８の各貫通孔３１，３２をそれぞれゆるく貫通している。また、各光学繊維束１８，１９の外装チューブ２６，２７は係止部材４２，４３を介してその固定部材４１，４１に取付け固定されている。さらに、基端側の係止部材４３と上記支持部材２８との間には固定部材４１に巻装した弾性部材としてのコイルばね４４，４４が介在していて、その固定部材４１，４１とともに、各光学繊維束１８，１９をその基端側へ弾性的に引つ張つている。

この実施例によれば、光学繊維束１８，１９自体も常にその基端側へ弾性的に引つ張るため、前述した実施例と同様にたるみが生じないことはもちろんのこと、圧縮力も全くかからない。

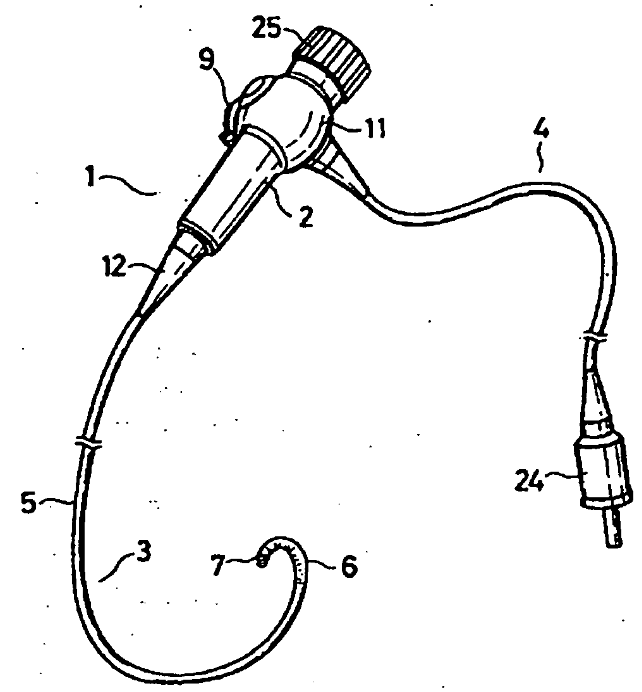
以上説明したように本発明は、特に挿入部を湾曲させる際、基端側へ移動する光学繊維束に圧縮力の増加につながるたるみの発生を防止するようにしたので、圧縮力に対してきわめて弱い光学繊維束がその湾曲操作やその繰り返しにより座折して各光学繊維が折れるという重大な支障を未然に解消できる。

図面の簡単な説明

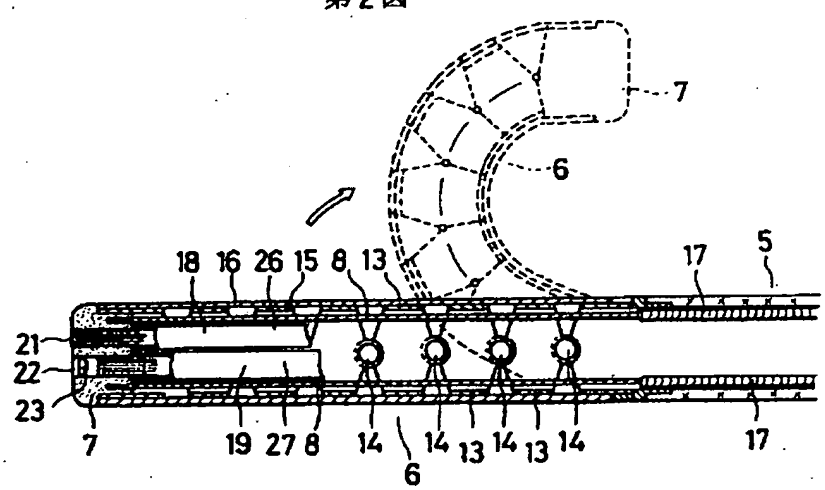
第１図は本発明の一実施例を示すその斜視図、第２図は同じくその挿入部の先端付近の側断面図、第３図は同じく挿入部の湾曲管の正面断面図、第４図は同じく操作部付近の要部を示す側断面図、第５図は第４図中Ｖ－Ｖ線に沿う断面図、第６図は本発明の他の実施例を示す操作部付近の要部を示す側断面図である。

１……軟性内視鏡、２……操作部、３……挿入部、１１……本体、１７……ワイヤガイド、１８……照明用光学繊維束、１９……観察用光学繊維束、２６……外装チューブ、２７……外装チューブ、２８……支持部材、３５……引張りチューブ、３６……引張りチューブ、４４……コイルばね。

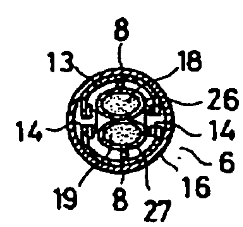
第1図


25
9
11
4
1
2
12
24
5
3
7
6

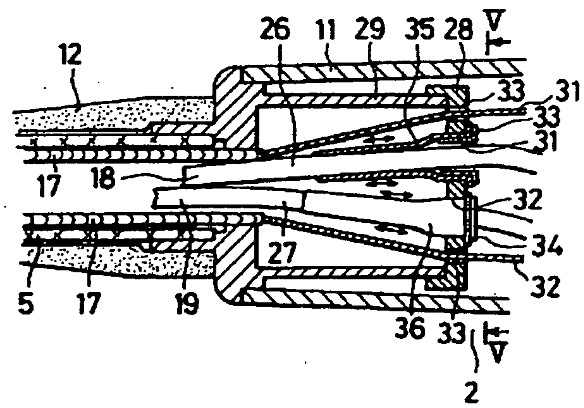
第2図


7
6
18 16 26 15 8 13
17 5
21
22
23
7 19 27 8 14 14 13 14 13 14 17
6

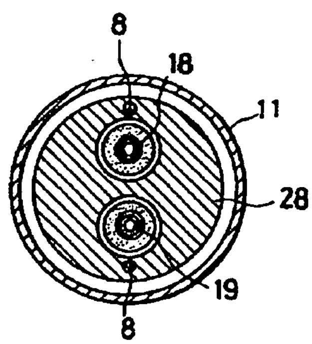
第3図


8
13 18
26
14 14
6
19 8 27 16

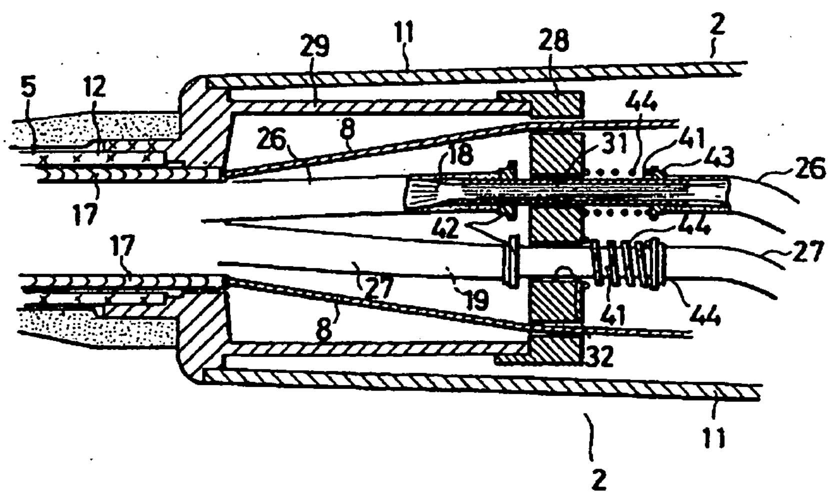
第4図


26
11
29
35
28
V
12
33
31
33
31
17
18
32
34
27
32
5
17
19
36
33
V
2

第5図


8
18
11
28
19
8

第6図


29
11
28
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12
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31
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44
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32
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11

Date: February 13, 2002

Declaration

I, Michihiko Matsuba, President of Fukuyama Sangyo Honyaku Center, Ltd., of 16-3, 2-chome, Nogami-cho, Fukuyama, Japan, do solemnly and sincerely declare that I understand well both the Japanese and English languages and that the attached document in English is a full and faithful translation, of the copy of Japanese Patent Publication No. Hei-3-42895 published on June 28, 1991.

M. Matsuba

Michihiko Matsuba

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SOFT ENDOSCOPE

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Inventor: Hideki SHIMONAKA

Applicant: Olympus Optical Co., Ltd.

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SPECIFICATION

[TITLE OF THE INVENTION] SOFT ENDOSCOPE

[WHAT IS CLAIMED IS:]

1 A soft endoscope, wherein an inserted part, which is to be inserted into a body cavity, is connected to a manipulating part and the inserted part is arranged to be curved by manipulation at said manipulating part, said soft endoscope being characterized in being equipped with a long optical fiber bundle, which is installed internally from said inserted part to manipulating part and with which the front end part is fixed to the front end portion of the inserted part, and an elastic member, which is connected to the base end part of said optical fiber bundle and elastically urges the optical fiber bundle

in the direction of the base end side to prevent sagging of the optical fiber bundle.

2 A soft endoscope as set forth in Claim 1, wherein said elastic member is installed inside said manipulating part and, in an elastically extended condition, has one end thereof connected to a sheath tube of said optical fiber bundle and has the other end thereof connected to a supporting member provided inside the manipulating part.

3 A soft endoscope as set forth in Claim 2, wherein said elastic member is an elastic tube that is fitted onto said optical fiber bundle.

4 A soft endoscope as set forth in Claim 1, wherein a fixed member, which is fixed with respect to all optical fibers of the optical fiber bundle part inside said manipulating part, is provided and said elastic member is connected via this fixed member to said optical fiber bundle.

[DETAILED DESCRIPTION OF THE INVENTION]

This invention relates to an improvement of a soft endoscope, with which an optical fiber bundle is inserted inside a curvable inserted part.

In general, the inserted part of a soft endoscope is arranged by providing a curvable tube at the front end of a

flexible tube that can be curved freely along the shape of a body cavity into which the inserted part is inserted, and this curvable tube part is arranged to be forcibly curved strongly by remote manipulation from a proximal manipulating part. An optical fiber bundle for illumination and an optical fiber bundle for observation are provided in the interior of this inserted part. These optical fiber bundles are not positioned at the central axis of the inserted part but are normally biased in position to the left, right, upper, or lower side. When the inserted part and especially the curvable tube part is curved, these parts become contracted in the axial direction at the inner side of the curve with respect to the central axis and become extended in the axial direction at the outer side of the curve. The respective internally-installed optical fiber bundles mentioned above are subject to the actions of this contraction and extension. However, since an optical fiber bundle has the characteristic of hardly extending or contracting, in the abovementioned curving process, an optical fiber bundle at the inner side of the curve becomes pushed towards the base end side while an optical fiber bundle at the outer side of the curve becomes pulled towards the front end side.

However, due to being inserted inside the body cavity

of a patient, the inserted part of an endoscope is made as small in outer diameter as possible in order to alleviate the pain applied to the patient, and the degree of packing of internal members is made extremely high accordingly. The abovementioned movements in the axial direction of the respective optical fiber bundles are thus readily obstructed and receive resistance. Since each optical fiber bundle itself has a soft flexible tube, when an optical fiber bundle is positioned at the inner side of the curve and is pushed towards the base end side, it sags readily and meanders inside the narrow inserted part, thereby increasing the resistance further, and when the curving operation is continued as it is, the compressive force that acts on the optical fiber increases.

Also for an optical fiber at the outer side of the curve, the compressive force increases in likewise manner when the curvature is returned to the original condition.

Though the abovementioned optical fiber bundles can withstand a tensile force to some degree, the bundles are extremely weak against a compressive force, and there was thus the serious problem that numerous optical fiber elements could buckle and break in the process of the curving manipulation (and especially when this manipulation process is repeated), thereby impeding observing and illumination.

This invention has been made in view of the above circumstances and an object thereof is to provide a soft endoscope, with which the sagging that tends to occur with the internally-installed optical fiber bundles in the process of curving the inserted part is absorbed, thereby prevent the arising of compressive forces in the axial direction of the optical fiber bundles that lead to the buckling and breaking of the optical fiber bundles.

An embodiment of this invention shall now be described with reference to Figs. 1 through 5.

In Fig. 1, 1 is a soft endoscope that is comprised of a manipulating part 2, a long inserted part 3, which is inserted inside a body cavity, and a light guide cable 4, which is connected to manipulating part 2. The abovementioned inserted part 3 has a front end member 7 connected, via a curvable tube 6, to the front end of a flexible tube 5 with flexibility, and this curvable tube 6 is arranged to be curved by remote manipulation, that is, by the pushing and pulling of manipulating wires 8, to be described below, by manipulation of an angle knob 9 of manipulating part 2. As shown in Fig. 4, the base end of the abovementioned flexible tube 5 is connected and fixed to the main body 11 of manipulating part 3, and the outer circumference of this part is fitted with a

bend-preventing rubber tube 12. Also, as shown in Figs. 2 and 3, curvable tube 6 has a plurality of joint rings 13 aligned in the length direction of inserted part 3, and adjacent joint rings 13 are pivotally joined by a rotating shaft 14, thereby making up a core member 15 that can be curved as a whole. The outer circumference of this core member 15 is covered by a sheath 16. Each of the abovementioned manipulating wires 8 is disposed near the inner circumference of core member 15 so as to be positioned farthest from rotating shafts 14 and the front end thereof is attached and fixed to front end member 7. Also, the base end sides of manipulating wires 8 are respectively guided to manipulating part 2 by being inserted through wire guides 17, which are arranged from closely-wound coils and are disposed inside flexible tube 5, are connected to an unillustrated curving manipulation mechanism, and are thus arranged to be pushed and pulled as described above.

An illuminating optical fiber bundle 18 and an observation optical fiber bundle 19 are inserted through the respective interiors of the above-described manipulating part 2 and inserted part 3. The front end part of illumination optical fiber bundle 18 is fitted inside and fixed to front end member 7 and is optically coupled to an illumination window 21. The front end part of observation optical fiber bundle

19 is fitted inside and fixed to front end member 7 and is optically coupled to an objective lens 23 at observation window 22. The base end side of illumination optical fiber bundle 18 is passed through the interior of light guide cable 4 from manipulating part 2 and reaches a connector 24. The base end side of observation optical fiber bundle 19 is optically coupled to an ocular part 25 at manipulating part 2. The above-described optical fiber bundles 18 and 19 are respectively covered by sheath tubes 26 and 27, which are made for example of silicon rubber and can expand and contract elastically.

Meanwhile as shown in Figs., 4 and 5, in the interior of the abovementioned manipulating part 2, a disk-shaped supporting member 28 is disposed so as to be orthogonal to the direction of the length axis of manipulating part 2 and is attached and fixed to a frame part 29, which extends from main body 11 of manipulating part 2. This supporting member 28 is furthermore provided with a pair of through holes 31 and 32, through which the abovementioned optical fiber bundles 18 and 19 are loosely inserted respectively, and a pair of through holes 33, through which the abovementioned manipulating wires 8 are loosely inserted respectively.

As has been mentioned above, the base end part of each

of the optical fiber bundles 18 and 19, which are installed internally from manipulating part 2 to inserted part 3 as has been described above, is pulled by a means that elastically urges these parts towards the base end side by means of an elastic member for prevention of sagging. That is, as shown in Figs. 4 and 5, with the present embodiment, the outer circumferences of sheath tubes 26 and 27, which are provided as elastic members at the outer circumferences of the respective optical fiber bundles 18 and 19 inside main body 11 of manipulating part 2, are loosely covered by tensioning tubes 35 and 36, respectively. The ends at one side of these tensioning tubes 35 and 36 are fixed and connected to the outer circumferences of the parts of the corresponding sheath tubes 26 and 27 that are positioned at the front end side of the abovementioned supporting member 28 and the ends at the other side of the respective tensioning tubes 35 and 36 are fitted into the corresponding through holes 31 and 32 and fixed and connected by fitting fixing members 33 and 34 to the supporting member 28. The abovementioned sheath tubes 26 and 27 are furthermore attached in the extended condition by tensioning tubes 31 and 32, respectively. The means for elastically urging the abovementioned sheath tubes 26 and 27 in a manner whereby the tubes are pulled towards the base end side is thus

arranged. Sheath tubes 26 and 27 are thus straightened in a pulled condition. Also, the parts of optical fiber bundles 18 and 19 inside the main body 11 of manipulating part 2 at the base end side of supporting member 28 are provided with a suitable sag to allow drawing out to some degree towards the front end side.

With the above-described arrangement, when the curvable tube 6 of inserted part 3 is curved forcibly as shown by the dotted line in Fig. 2, though the illumination optical fiber bundle 18, which is positioned at the inner side of the curve, becomes compressed and becomes pushed towards the base end side, since this optical fiber bundle is covered by the sheath tube 26, which is constantly maintained in the straight condition by being pulled as has been described above, sagging does not occur. At the same time, though the observation optical fiber bundle 19 at the outer side of the curve becomes pulled in the opposite direction and towards the front end, since a suitable allowance is provided inside manipulating part 2 behind supporting member 28 and also since sheath tube27 is provided with elasticity, the optical fiber bundle and the sheath tube can be drawn towards the front end side without strain.

In being returned to the original condition and curved in the opposite direction from the above-described curved

condition, though the directions of movement of the optical fiber bundles 18 and 19 will be opposite those mentioned above, the optical fiber bundles will be prevented from sagging by the action of sheath tube 27. Since each of the optical fiber bundles 18 and 19, which are installed inside the narrow inserted part 3, are thus prevented from sagging, their sliding movements in the axial direction are carried out smoothly. The impeding of the sliding movements in the axial direction due to sagging and the consequent buckling and breakage due to the application of compressive force on the optical fibers that are extremely weak to compressive force can thus be prevented in advance.

Though sheath tubes 26 and 27 were used as the elastic members in the present embodiment, the tensioning tubes 35 and 36 can be provided with elasticity and used as the elastic members. That is, it is sufficient that at least one of either the sheath tubes 26 and 27 or the tensioning tubes 35 and 36 be arranged as members that extend and contract elastically.

Fig. 6 shows another embodiment of this invention. With this embodiment, intermediate parts of the respective optical fiber bundles 18 and 19 that are positioned inside main body 11 of manipulating part 2 are integrally attached and fixed to fixed members 41. At this fixed part, the optical fibers

are fixed together integrally by means of an adhesive agent. Furthermore, fixed members 41 are respectively passed loosely through the through holes 31 and 32 of the supporting member 28. The sheath tubes 26 and 27 of optical fiber bundles 18 and 19 are respectively attached and fixed to fixed members 41 via engaging members 42 and 43. Furthermore, coil springs 44, which serve as elastic members that are wound around fixing members 41, are respectively interposed between latching members 43 at the base end side and the abovementioned supporting member 28 and elastically pull optical fiber bundles 18 and 19 along with fixing members 41 towards the base end side.

With this embodiment, since optical fiber bundles 18 and 19 themselves are also pulled elastically towards the base end side, not only does sagging obviously not occur as in the formerly described embodiment but a compressive force is also not applied at all.

As has been described above, with the present embodiment, since the occurrence of sagging, which leads to increase in compressive force applied to the optical fiber bundles that are moved towards the base end side, especially in the process of curving the inserted part, is prevented, the serious problem of buckling of optical fiber bundles, which are extremely weak

to compressive force, due to the curving manipulation or repetition thereof and the consequent breakage of the optical fibers can be resolved in advance.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a perspective view, which shows an embodiment of this invention, Fig. 2 is a side section of the vicinity of the front end of the inserted part of the same, Fig. 3 is a front section of the curvable tube of the inserted part of the same, Fig. 4 is a side section, which shows the principal parts near the manipulating part of the same, Fig. 5 is a section along line V-V of Fig. 4, and Fig. 6 is a side section, which shows the principal parts near the manipulating part of another embodiment of this invention.

[Reference Numerals]

1 soft endoscope

2 manipulating part

3 inserted part

11 main body

17 wire guide

18 illumination optical fiber bundle

19 observation optical fiber bundle

26 sheath tube

27 sheath tube

28 supporting member

35 tensioning tube

36 tensioning tube

44 coil spring

Fig.1

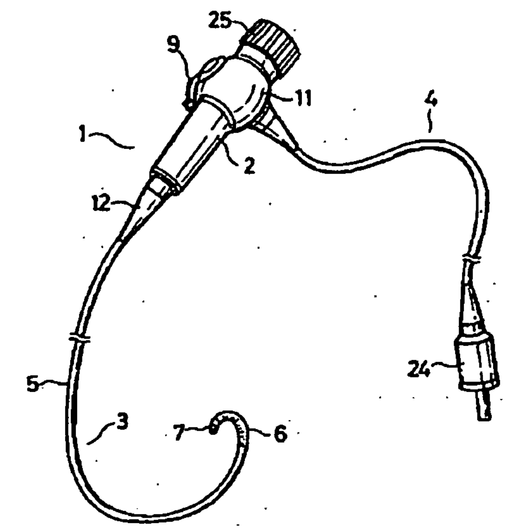

Fig.2

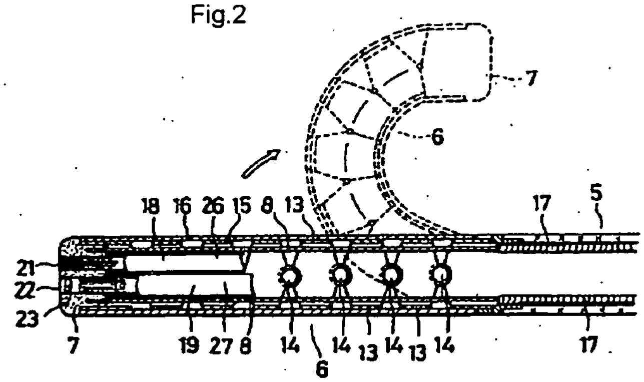

Fig.3

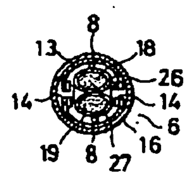

Fig.4

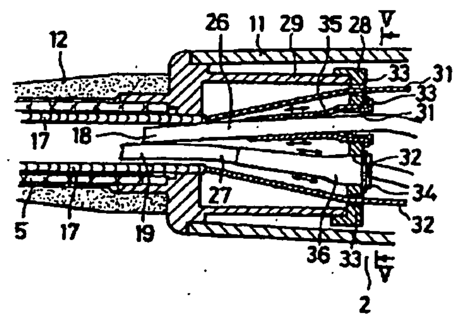

Fig.5

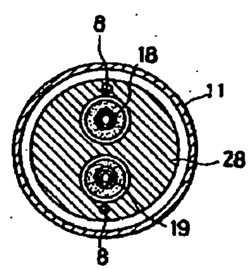

Fig.6